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Terranal Affinities of Original Chouteau Limestone

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TERRANAL AFFINITIES OF ORIGINAL CHOUTEAU LIMESTONE.

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In all the Mississippi valley there is no geologic formation that is so misunderstood, or so illy considered as regards its stratigraphic relations, as the massive, buff limestone terrane immediately underlying the Burlington limestone of Missouri and Iowa. Originally noticed by Prof. G. C. Swallow,[1] in 1855, as a thick, homogeneous lithologic unit typically developed in central Missouri along the northern flanks of the Ozark dome, and extended into other parts of the state as the uppermost member of a tripartite "Chemung" group, little mention is later made of it.

When, a generation after Swallow, Prof. H. S. Williams[2] revived the title it was with an entirely different meaning; the term then applying not to a terrane at all but to a fauna carried by all of the Early Carboniferous rock-section beneath the Burlington horizon. In this he followed Prof. G. C. Broadhead[3] who had, in 1874, proposed the name Chouteau Group to take the place of Chemung Group of the previous accounts of the region. In the earlier reports of the present Geological Survey of Missouri[4] the term, in Swallow's original sense, is repeatedly recognized. Prof. E. M. Shepard reports[5] the formation in its typical development to occur in Greene county, in southwestern Missouri. In the north, in Iowa, the Chouteau limestone is not generally recognized by title, yet it is several times so called in the central part of the state.[6]

In Illinois, where the Chouteau limestone is not known to be represented, the terrane is commonly merged with the Kinderhook group, as is done by F. B. Meek and A. H. Worthen[7]. Through the wide usage of the latter title Swallow's name is

[1]Missouri Geol. Surv., 1st and 2d Ann. Repts., p. 102, 1855.
[2]Bull. 80, U. S. G. S., p. 169, 1891.
[3]Missouri Geol. Surv., Rept. 1873-4, p. 26, 1874.
[4]Missouri Geol. Surv., Vol. IV, p. 57, 1894.
[5]Ibid., Vol. XII, 1898.
[6]Iowa Geol. Surv., Vol. XXII, p. 154, 1913.
[7]Am. Jour. Sci., (2), Vol. XXXII, p. 288, 1861.

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gradually lost sight of. Whenever reference is made to the uppermost member of the succession it is called the Kinderhook limestone[8].

Singularly enough, since Swallow's time, the Chouteau limestone in its original locality has never been carefully studied. Few persons have taken the opportunity to inspect the type-sections. The eastward attenuation of the formation, in eastern Missouri, where it again reaches sky after burial in a broad syncline, has made the terrane appear to be an unimportant member of the so-called Kinderhook section.

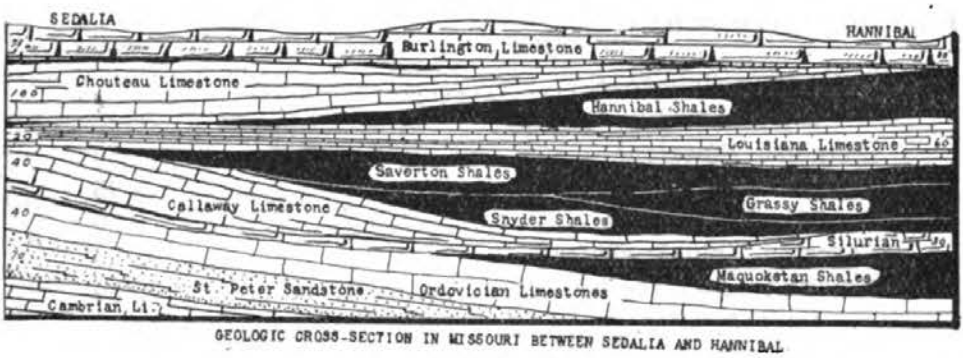
In recent years a large number of deep-well records enables the underground extent and thickness of many formations in Missouri and Iowa to be accurately traced and determined far from their lines of outcrop. Among the terranes of this class is the Chouteau limestone. The data bearing upon its stratigraphic relations permit it to be clearly delimited from Minnesota to Arkansas, a distance of more than 600 miles. As a definite lithologic unit and a sharply delimited terrane the Chouteau limestone presents some features of more than local interest in general geologic correlation.

At the original locality, at Chouteau Springs, central Missouri, and at neighboring places in Saline, Cooper and Pettis counties, the interval of 125 feet between the undoubted Devonian Callaway limestone and the Early Carboniferous Burlington limestone is occupied by grey limestones. This circumstance leads Professor Stuart Weller[9] to regard the original Chouteau section as representing the entire Kinderhook succession of other parts of the Mississippi valley. Swallow[10] from the first recognized the fact that the entire section of his "Chemung" (Kinderhook) group, which in other parts of Missouri is a three-fold division, is in the central portion of the state an unbroken sequence of limestone layers. Nevertheless, he considers[11] the lower twenty feet as the Lithographic (Louisiana) limestone division; and the middle part as replacing the Vermicular (Hannibal) shales of elsewhere.

Recent observations show that Swallow is mistaken only in a single point. Not finding the Vermicular shales in distinct development in Cooper county as elsewhere he assumes them to be

[8]Iowa Geol. Surv., Vol. I, p. 56, 1893.
[9]Bull. Geol. Soc. America, Vol. XX, p. 321, 1909.
[10]Missouri Geol. Surv., 1st and 2d Ann. Repts., p. 195, 1855.
[11]Ibid., p. 103.

replaced by limestone. In other parts of Missouri he clearly considers the Chouteau limestone as the upper member of his "Chumung" group.



GEOLOGIC CROSS-SECTION IN MISSOURI BETWEEN SEDALIA AND HANNIBAL

FIG. 7.

Two geological cross-sections constructed at right angles to each other and intersecting at Chouteau Springs quickly set to rights all the conflicting notions of the past fifty years concerning the stratigraphic relations of the Chouteau limestone. One cross-section extends from Hannibal (near Kinderhook, Illinois) on the Mississippi river, to Sedalia, in Pettis county, a distance of one hundred thirty miles (figure 7). The other section, fifty

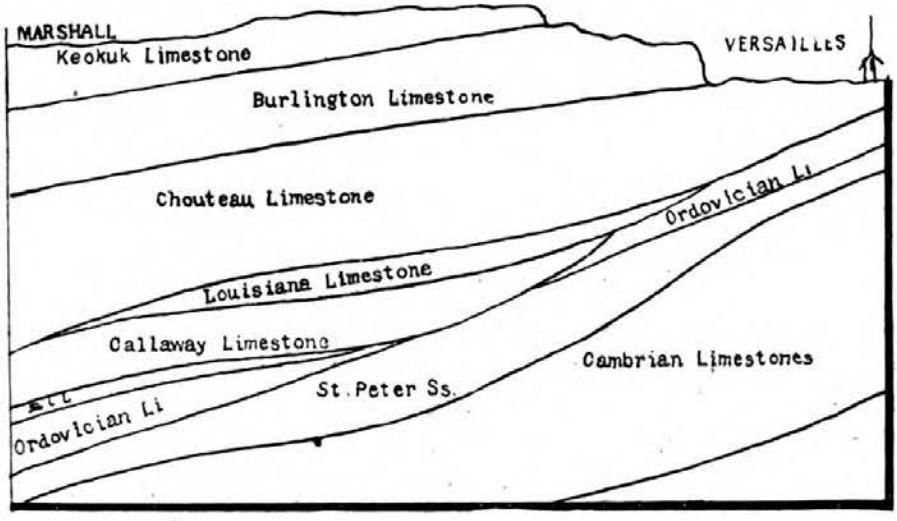


FIG. 8—Chouteau terrane at type locality.

miles in length, traverses Saline, Cooper and Morgan counties, from the town of Marshall to that of Versailles (figure 8). Both sections are checked at frequent intervals by rock exposures and by well records.

As recently shown [12] the Early Carboniferous section beneath the Burlington limestone, in northeast Missouri, embraces more than the three members originally ascribed to it. Two other members properly belong to its base. This section presents the following succession:

	Feet
Burlington limestone	.
Unconformity.	
Chouteau limestone	30
Hannibal shales	75
Louisiana limestone	50
Saverton (blue) shales	50
Grassy (black) shales	40
Unconformity.	

By reference to the principal cross-section (figure 8) it is noted that the Chouteau limestone, which is a hundred feet thick at the typical locality, gradually becomes thinner until it vanishes completely just before the Mississippi river is reached, where the Burlington limestone lies immediately upon the Hannibal shales. On the other hand the Hannibal shales, which are seventy-five feet in vertical measurement at the east end of the section, decline in thickness westward until by the time Cooper county is reached they disappear by attenuation, and the Chouteau and Louisiana members come together. The last mentioned limestone, which is sixty feet thick at the Mississippi river, also becomes reduced to the west until in Cooper county it has only about one-third its original measurement. It appears, therefore, that Swallow[13] was actually correct in assigning the lower twenty feet of the Cooper county "Chemung" (Kinderhook) to the Lithographic (Louisiana) limestone.

The Saverton shales, Grassy (black) shales, and the Snyder (Devonian, Lime Creek) shales also chance to thin out towards the west, so that at the western border of Cooper county the Carboniferous limestones rest directly upon the Callaway (Devonian) limestones. Moreover, the Buffalo (Maquoketan) shales, which are well developed on the Mississippi river, vanish completely within a distance of fifty miles of that stream. In central Missouri there is, then, a rock succession extending from the St. Peter sandstone to the Coal Measures that is without a single shale or sandstone layer to relieve the limestone uniformity. This is the reason why it is so difficult usually to interpret satis-

[12] Am. Jour. Sci., (4), Vol. XXXVI, p. 160, 1913.
[13] Missouri Geol. Surv., 1st and 2d Ann. Repts., p. 103, 1855.

factorily the deep-well records of the region; and why driller's logs are really more accurate than is commonly claimed for them.

Viewing the Chouteau limestone strictly as a lithologic unit, delimited with unusual sharpness as it happens, several points are to be especially emphasized. The eastern attenuated margin of the formation very nearly coincides with the course of the Mississippi river from the mouth of the Iowa river to that of the Missouri river. Nowhere does the terrane appear actually to touch the banks of the great stream. Chouteau limestone is reported to be represented at several points on the river, as at Louisiana[14] and Hannibal, in northeast Missouri, and at Burlington[15], Iowa. The thin bed referred to at these places may represent an earthy phase of the Burlington formation, for in this region the latter formation actually rests in marked unconformity upon the Hannibal shales.

In Iowa, north of the original locality, the Chouteau limestone commonly goes under the title of Kinderhook Beds[16]. The formation becomes thicker, reaching a measurement of one hundred fifty feet in the central portions of the state. Near the Minnesota boundary, where the Paleozoics are upturned as one limb of the now truncated arch which once formed the Siouan mountains, the thickness is even greater. The formation, after crossing this great Triassic flexure, probably extends northwestwardly far into Canada.

Between the Missouri river and the Minnesota state-line, a distance of more than three hundred miles, the Chouteau limestone has a thickness of one hundred to one hundred fifty feet. Numerous deep-well records in this belt enable the limestone plate to be traced for a distance of seventy-five miles from its outcropping.

The axis of the broad syncline lying between Chouteau Springs and Hannibal extends southwestward over the present Ozark dome, which of course did not exist in Early Carboniferous times. When the Kinderhook rocks again appear in southwest Missouri the same tripartite character as presented in the north part of the state seems to hold. At Springfield Swallow's original interpretation[17] of the sequence appears to be in the main correct. With the elimination of the so-called Devonian beds of the same

[14]Am. Jour. Sci., (3), Vol. XLIV, p. 449, 1892.
[15]Bull. Geol. Soc. America, Vol. III, p. 285, 1892.
[16]Iowa Geol. Surv., Vol. I, p. 56, 1893.
[17]Missouri Geol. Surv., 1st and 2d Ann. Repts., p. 103, 1855.

section Prof. E. M. Shepard's recognition[18] of the Chouteau, Hannibal and Louisiana members also seems to be fully substantiated by recent observations. Still later Prof. Stuart Weller,[19] from a critical study of the fossils found in the so-called Northview sandstone (Hannibal), furnishes indubitable evidence in support of the early interpretations. By showing the identity of the Northview fauna with that of the beds lying immediately beneath the Burlington limestone at Burlington, Iowa, correlation with the Hannibal shale seems complete. At Burlington the latter are known to cover the interval of fifty feet between the base of the Burlington limestone and the horizon of the Louisiania limestone.[20]

The correlation of the original Chouteau limestone with the recently proposed Fern Glen formation, twenty miles west of St. Louis, presents many uncertainties. South of the Missouri river the lowermost Burlington limestones lose their characteristic lithologic features. They no longer remain crinoidal breccias. Texturally they strongly resemble the typical Chouteau and Louisiana limestones. The red coloration, so conspicuous northward at Burlington city, persists. As described in detail by Professor Weller[21] the fauna appears to be identical with that of the red Burlington beds occupying the lower twenty to thirty feet of the Iowa section. Aside from a few weeks' collecting in the typical Lower Burlington strata, by the late Doctor Wachsmuth and myself, no crinoids of consequence have been obtained at Burlington in forty years, so that the determination of the zonal distribution of these forms has not been recently possible. The figures of the Fern Glen fossils seem to represent leading species which Niles and Wachsmuth[22] long ago listed as characterizing their Lower Burlington division of the Iowa section. These facts are admirably brought out by Professor Weller[23] in his late discussion of the affinities of the Fern Glen faunas.

[18]Ibid., Vol. XII, p. 49, 1898.
[19]Journal of Geology, Vol. IX, p. 130, 1901.
[20]Am. Jour. Sci., (4), Vol. XXXVI, p. 161, 1913.
[21]Geol. Soc. America, Vol. XX, p. 265, 1909.
[22]Am. Jour. Sci., (2), Vol. XLII, p. 95, 1866.
[23]Bull. Geol. Soc. America, Vol. XX, p. 265, 1909.